

6.0 Alternatives and Options Comparison

Reclamation will select one or more water delivery alternatives and water supply options evaluated during the appraisal-level investigation for more comprehensive feasibility-level investigation. The selection will consider engineering technical feasibility and costs; the alternatives' and options' performance in meeting Study objectives; and potential environmental and other resources issues associated with each. This chapter compares the alternatives and options performance in meeting Study objectives and identifies potential fish and wildlife, cultural, and land use issues. This comparison relied on existing available data and information and is considered only a preliminary assessment of possible issues.

6.1 Study Objective Measures

In the previous Study phase (Section 1.4, PASS), seven Study objectives, or guidance measures, were developed by stakeholders to evaluate and rank potential alternative concepts. The identification of these Study objectives is described in *Initial Alternatives Development and Evaluation* (Reclamation 2006). The following describes the information and measures used to compare the alternatives and options using these Study objectives:

- **Replace all or a portion of current groundwater withdrawals within the Study area with CBP water.** There are 140,000 eligible groundwater-irrigated acres within the Study area. Reclamation determined the number of current groundwater-irrigated acres that could receive CBP water as a replacement supply for each water delivery alternative and water supply option. Alternatives and options that would provide water to the greatest number of acres are preferred.
- **Maximize use of existing CBP infrastructure.** Alternatives and options that use existing CBP infrastructure by modifying operations or expanding existing facilities, as opposed to constructing new facilities, would be ranked higher. Relying on existing CBP facilities should result in smaller expenditures of funding and study time and expedite implementation of a preferred alternative.
- **Retain the possibility of full CBP development in the future.** Implementing an alternative or option should not prevent Reclamation from completing full development of the CBP in the future. (This Study is not investigating completion of the CBP.) Full development would entail eventual irrigation of 1,029,000 acres of lands.
- **Address ESA issues, including the NMFS's Columbia River seasonal flow objectives for salmon and steelhead, and potential impacts to shrub-steppe habitat.** Reclamation examined alternatives and options that would not affect Columbia River flow objectives identified by NMFS for ESA-listed salmon and steelhead. Reclamation also determined the acres of shrub-steppe habitat potentially affected by an alternative or option. Shrub-steppe habitat is important for a number of Federal and State Species of Concern. Alternatives and options that would affect the smallest shrub-steppe habitat acreage would be ranked higher.

- **Provide environmental and recreational enhancements.** Alternatives and options that could provide additional recreation opportunities or benefit wildlife and fish habitat would be ranked higher.
- **Minimize potential delay in the Study schedule.** Many consider the potential regional economic effects from continued aquifer decline to be at a critical point. Alternatives and options that can be studied and implemented as quickly as possible to minimize these effects are preferred.
- **Be developed in phases based on funding expectations, physical and operational constraints, and rate of groundwater decline.** Alternatives that could provide replacement water in a timely manner that would minimize disruption to existing CBP operations and work within budget constraints would be preferred. This is best achieved by selecting alternatives and options that can be studied and constructed in phases, to facilitate and expedite implementation.

Data collected or developed during the appraisal-level investigation were used to compare the ability of each alternative or option to accomplish each Study objective. Because the appraisal-level investigation relied on readily available information, quantitative data were not always available to compare performance of alternatives and options for all Study objectives. A combination of quantitative and qualitative information was compiled and is summarized in tables. These tables compare each water delivery alternative and water supply option, respectively, with respect to its ability to meet the Study objectives.

6.2 Environmental and Other Issues and Considerations

Potential environmental and cultural issues and concerns were identified for each alternative and option using readily available data. Much of the information described here was obtained from GIS databases developed by Federal and State agencies and communications with other agencies. The information is preliminary, as not all databases encompass the entire Study area. Extensive environmental surveys and analyses will be performed in the next Study phase to verify the presence of these resources and assess any potential effects. The information presented here is appropriate for appraisal-level investigation to identify major constraints to implementing an alternative or issues that make an alternative infeasible or potentially cost prohibitive. Issues may include:

- **Fish and Wildlife.** Reclamation, with the assistance of the FWS and WDFW, conducted an appraisal-level overview of potential fish and wildlife issues for each water delivery alternative and water supply option. The potential to affect wildlife-related recreation, such as hunting, fishing, and wildlife observation, was also considered. Much of this data were compiled from GIS datasets readily available to Reclamation such as the WDFW Heritage Dataset and Priority Habitats. However, not all datasets provide coverage for all of the Study area and may not adequately represent species occurrence. Additional surveys and studies will be required to verify presence.
- **Cultural Resources.** A high-level Class 1 inventory of cultural resources, summarized in Section 2.8. Historic and Prehistoric Resources, was conducted for most of the Study area. This survey reviewed information from previously recorded cultural resources. However, much of Study area has not been surveyed; more extensive surveys will be

conducted in areas that may be affected by proposed alternatives and options selected for study in the next Study phase.

- **Land Use.** This assessment considered land uses that occurred within the footprint of proposed reservoirs. The inventory relied on GIS datasets that identified landownership and structures such as residences, roads, and railroads. This initial assessment was completed for the water supply options only.

6.3 Water Delivery Alternative Comparison

The four water delivery alternatives were compared for performance on Study objectives. Potential environmental and other issues were identified.

6.3.1 Study Objectives Comparison

Reclamation could fully develop the CBP in the future—regardless of the water delivery alternative selected. All alternatives are conducive to a phased study and construction approach.

Alternatives A and B would provide a replacement water supply to the greatest number of groundwater-irrigated acres, as they are configured to deliver a replacement water supply to all (alternative A – 140,000 acres) or most (alternative B – 127,3000 acres) of the eligible acres. Both of these alternatives entail construction of a new East High canal system and involve significant miles of new major canals, tunnels, and siphons, and a number of pumping plants as well as a re-regulating reservoir. The magnitude of new construction required would entail potentially greater study time, resources, and effort to complete the necessary level of engineering and environmental analyses. Despite this, these alternatives can be studied and implemented in increments, potentially expediting water delivery to some lands more quickly. Alternative B offers the greatest flexibility in terms of the number of infrastructure configurations possible. These alternatives may also have more significant environmental effects to address as they involve larger areas of disturbance.

Alternatives C and D best maximize the use of existing CBP infrastructure, both relying on the existing East Low Canal system. However, alternative C would still entail extensive construction to expand the capacity of the existing East Low Canal system. As currently configured, alternative C could cost as much or more to operate than the East High canal system (alternatives A and B) because of the maintenance and power associated with the numerous pumping plants required to pump replacement water to higher elevation lands. The East High canal system, as configured in alternatives A and B, would deliver water to some lands by gravity and some by pumping and would not need to pump water as high as the East Low Canal. Initial cost estimates in terms of groundwater acres served indicate that alternatives A and B may be comparable to alternative C.

Alternative D may result in the least amount of environmental impacts because it would rely on the existing conveyance system with less construction. It would also rank the highest of the four alternatives considered in terms of the amount of funding and time required to study the alternative. However, it would deliver a replacement water supply to the least amount of groundwater acreage—only 29 percent of the total.

Table 30 provides information to allow comparison of the water delivery alternatives' abilities to meet Study objectives. Table 30. Study objective performance comparison by water delivery alternative

Study Objective	Alternative A	Alternative B	Alternative C	Alternative D
<i>Replace all or portion of current groundwater within the Study area with CBP water (groundwater-irrigated acres replaced).</i>	140,000 acres 100%	127,300 acres 91%	70,100 acres 50%	40,700 acres 29%
<i>Maximize use of existing infrastructure (no/minimal impact to existing users).</i>	<p>Significant new infrastructure construction, including East High canal system and Black Rock re-regulating reservoir.</p> <p>Requires new pipelines, laterals and pumping plants to convey water from main canals to irrigated lands.</p> <p>Construction of the inlet structure at the Main Canal will need to coordinate to not interfere with current irrigation delivery.</p>	<p>Significant new infrastructure construction, including East High canal system and Black Rock re-regulating reservoir.</p> <p>Expands capacity of southern portion of the existing East Low Canal; and extends it by 2.3 miles.</p> <p>Implementation of East Low Canal component will need to coordinate construction to not interfere with current irrigation delivery.</p> <p>Requires new pipelines, laterals and pumping plants to convey water from main canals to irrigated lands.</p>	<p>Expands capacity of southern portion of the existing East Low Canal.</p> <p>Implementing East Low Canal component will need to coordinate construction to not interfere with current irrigation delivery.</p> <p>Requires new pipelines, laterals, and pumping plants to convey water from main canals to irrigated lands.</p>	<p>Uses existing East Low Canal capacity and adjustments in operations.</p> <p>Requires new pipelines, laterals, and pumping plants to convey water from main canals to irrigated lands.</p>
<i>Retain the possibility of full CBP development in the future.</i>	Yes	Yes	Yes	Yes

Address ESA issues (NMFS Columbia River flow objectives, shrub-steppe habitat impacts.)	No effects to Columbia River ESA flow objectives anticipated. New canal infrastructure construction would bisect large areas of shrub-steppe habitat.	No effects to Columbia River ESA flow objectives anticipated. New canal infrastructure construction would bisect large areas of shrub-steppe habitat.	No effects to Columbia River ESA flow objectives anticipated. Laterals may cross some areas of shrub-steppe habitat.	No effects to Columbia River ESA flow objectives anticipated. Minimal effects to shrub-steppe habitat anticipated.
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Table 31. Study objective performance comparison by water delivery alternative

Study Objective	Alternative A	Alternative B	Alternative C	Alternative D
Provide environmental and recreational enhancements.	Possible secondary benefits from conveyance facilities seepage that may result in wetlands and wildlife habitat.	Possible secondary benefits from conveyance facilities' seepage that may result in wetlands and wildlife habitat, although not as great as alternative A.	Possible secondary benefits from conveyance facilities' seepage that may result in wetlands and wildlife habitat, although not as great as alternatives A or B.	Possible secondary benefits from conveyance facilities' seepage that may result in wetlands and wildlife habitat, although not as great as alternatives A, B, or C.
Minimize Study schedule delays (NEPA/Feasibility completed in 2011).	Significant new infrastructure entails greater engineering design effort to complete.	New infrastructure entails greater engineering design effort and time.	Will require more time to study than alternative D, but not as much as alternatives A and B.	Least amount of study time required.
Developed in phases.	Conductive to an incremental phased implementation approach; desirable and necessary given the implementation costs and anticipated construction schedule.	Conductive to an incremental phased implementation approach; desirable and necessary given the implementation costs and anticipated construction schedule.	Conductive to an incremental phased implementation approach.	Conductive to an incremental phased implementation approach.

6.3.2 Environmental and Other Resources Issues

In general, the more construction required, the more acreage may be disturbed and the greater the potential for effects to environmental and other resources.

Fish and Wildlife Issues

Potential fish and wildlife issues associated with the water delivery alternatives include loss of terrestrial habitat due to destruction, fragmentation, or inundation. Habitats of particular concern in the Study area include shrub-steppe, cliffs, rock outcrops, and talus slopes. Many Federal and State Species of Concern depend on or use these habitat types. As described in Section 2.7, Fish and Wildlife, WDFW believes that over half of the shrub-steppe habitat in the State has already been lost to development. Alternatives that affect large acreages would cause concern. New canals and laterals bisecting through currently intact habitat areas could fragment remaining habitat and interfere with species dispersal.

All alternatives have the potential to affect wildlife-related recreation activities either negatively or positively. Constructing new canals and laterals, and the resulting seepage, could create new habitat that may benefit some species.

Water delivery alternatives A and B have the greatest potential to impact fish and wildlife because larger land areas would be disturbed to construct new infrastructure, thus bisecting shrub-steppe habitat. These alternatives also require larger volumes of a replacement water supply. See Section 6.4 “Water Supply Option Comparison” for a discussion of potential issues associated with a water supply. Table 32 summarizes the potential occurrence of Federal and State species of concern in areas where alternatives are proposed. Table 33 summarizes potential fish and wildlife issues and concerns for each water delivery alternative.

Cultural Resource Issues

Information on potential cultural resources within the Study area is limited. Previous surveys have occurred in response to development activities (e.g., roads). Reclamation will conduct additional surveys in future Study phases to determine the presence and significance of any cultural resources. Water delivery alternatives A and B, which involve more miles of new construction and disturbance, have a greater probability of encountering cultural resources along their alignment compared to alternatives C and D, which involve construction largely in previously disturbed areas. The East Low Canal is eligible for listing on the NHRP.

6.4 Water Supply Option Comparison

Water supply options considered during the appraisal-level investigation included modifying operations at existing storage facilities, including Banks Lake and Potholes Reservoir, or constructing new storage facilities at three possible locations: Dry Coulee, Rocky Coulee or Lower Crab Creek. In general, modifying operations at existing storage facilities best meets the identified Study objectives and introduces fewer environmental issues and concerns compared to construction of new storage facilities.

Table 32. Potential occurrence of Federal and State species of concern

Species	Alternative A	Alternative B	Alternative C	Alternative D
Federal Endangered				
Columbia River basin pygmy rabbit	P*	P	P	
Federal Candidate				
Washington ground squirrel	L	L	P	P
Greater sage grouse	L	L		
State Endangered				
Northern leopard frog	P	P		
American white pelican	P	P		
Sandhill crane	P	P		
State Threatened				
Bald eagle	P	P		
Ferruginous hawk	L	L	P	P
State Sensitive				
Common loon	P	P		
Peregrine falcon	P	P		
State Candidate				
Burrowing owl	P	K	K	P
Golden eagle	P	P	P	P
Loggerhead shrike	K	K	P	P
Merlin	P	P	P	P
Merriam's shrew	P	P	P	P
Washington ground squirrel	L	L	P	P
Sagebrush lizard	L	L	P	P
Sage thrasher	L	L		
Sage sparrow	L	L		
Western grebe	P	P		

Table 32. Potential occurrence of Federal and State species of concern

Species	Alternative A	Alternative B	Alternative C	Alternative D
Black-tailed jackrabbit	P	P		
Townsend's big-eared bat	P	P		
Pallid Townsend's big-eared bat	P	P		

*K= Known occurrence; L = Likely occurrence; P = Possible occurrence.

6.4.1 Study Objectives Comparison

Water supply options that use existing storage facilities best meet the Study objectives. These options are the most cost effective in terms of volume of water supplied per dollar spent and would likely require fewer resources and effort to complete the necessary level of engineering and environmental analyses.

Drawing Banks Lake down or constructing large new storage facilities, such as proposed at Dry Coulee or Lower Crab Creek are the only options that could provide sufficient water to replace all eligible groundwater acreage. Constructing new storage is costly and may result in greater environmental issues compared to drawing down Banks Lake. However, significant draw down of Banks Lake would be required to provide a full replacement water supply. A combination of several water supply options will likely be needed to minimize potential effects and provide sufficient water in a cost-effective manner. Modifying operations at Banks Lake, combined with modifications at Potholes Reservoir, could provide sufficient water for all groundwater-irrigated acres in the Study area and had the best performance for the majority of Study objectives.

Of the proposed storage reservoirs, Rocky Coulee is the most economical to construct and has fewer complex environmental issues compared to the Dry Coulee and Lower Crab Creek sites. However, Rocky Coulee can only provide a replacement water supply for up to 34 percent of the groundwater-irrigated acres and would need to be used in conjunction with other measures. Dry Coulee is in a central location and is ideally located for effective CBP operations. Lower Crab Creek is the least effective operationally as it would require pumping water from Grand Coulee Dam twice (once to fill the proposed Lower Crab Creek reservoir and a second time to supply groundwater-irrigated land) and would result in reduced flows in the Columbia River from Grand Coulee Dam to the mouth of Lower Crab Creek.

Reclamation could fully develop the CBP in the future regardless of the water supply options selected. All options are conducive to a phased study and construction approach. Table 35 provides information to allow comparisons of each water supply option's ability to meet Study objectives.

Table 33. Comparison of potential fish and wildlife issues by water delivery alternative

Alternative A	Alternative B	Alternative C	Alternative D
<p>Upper end of East High canal system crosses significant areas of shrub-steppe habitat.</p> <p>The new East High canal system might result in barriers to wildlife (e.g., mule deer), fragmented habitat (e.g., Washington ground squirrel), or may be constructed near areas where sensitive species nest (e.g., ferruginous hawks or loggerhead shrikes).</p> <p>Potential for effects to wildlife-related recreation.</p> <p>Potentially supports 3 Federal and 17 State Species of Concern.</p> <p>Black Rock Coulee re-regulating reservoir site potentially supports 20 State Species of Concern. It would inundate habitat for State Threatened and candidate species (e.g., loggerhead ferruginous hawk, loggerhead shrike and Washington ground squirrel).</p>	<p>Upper end of East High canal system crosses significant areas of shrub-steppe habitat.</p> <p>The new East High canal system might result in barriers to wildlife (e.g., mule deer), fragmented habitat (e.g., Washington ground squirrel), or may be constructed near areas where sensitive species nest (e.g., ferruginous hawks or loggerhead shrikes).</p> <p>Black Rock re-regulating reservoir—Same as alternative A.</p> <p>The East Low Canal enlargement might further limit dispersal potential of mammals and reptiles if enlargement makes crossing the canal more difficult and may occur in areas supporting a high density of burrowing owl nesting sites.</p> <p>Potential for effects to wildlife related recreation.</p> <p>Potentially supports 3 Federal and 17 State Species of Concern.</p>	<p>The East Low Canal enlargement might further limit dispersal potential of mammals and reptiles if enlargement makes crossing the canal more difficult and may occur in areas supporting a high density of burrowing owl nesting sites.</p> <p>Laterals may affect some shrub-steppe habitat.</p> <p>Potential for effects to wildlife-related recreation.</p> <p>Potentially supports 2 Federal and 8 State Species of Concern.</p>	<p>Predominantly cropland.</p> <p>Laterals may affect some shrub-steppe habitat.</p> <p>Potential for effects to wildlife related recreation.</p> <p>Potentially supports 1 Federal and 8 State Species of Concern.</p>

Table 34. Study objectives performance comparison for water supply options

Study Objective	Banks Lake Drawdown	Banks Lake Raise	Potholes Reoperation	Dry Coulee	Rocky Coulee	Lower Crab Creek (472 KAF)	Lower Crab Creek (200 KAF)
<i>Replace all or portion of current groundwater within the Study area with CBP water (groundwater-irrigated acres replaced).</i>	Up to 140,000 acres 100%	Up to 16,700 acres 12% (50 KAF)	Up to 16,700 acres 12% (50 KAF)	Up to 140,000 acres 100% (481 KAF)	Up to 46,900 acres 34% (126 KAF)	Up to 140,000 acres 100% (472 KAF)	Up to 60,000 acres 43% (200 KAF)
<i>Maximize use of existing infrastructure (no/minimal impact to existing users).</i>	Yes; new impacts to users of recreation and other resources from draw down lower than current operations.	Yes; requires modifications to both dams and to Grand Coulee Feeder Canal.	Yes; requires modification at dam; flood evacuation route downstream.	New construction.	New construction.	New construction.	New construction.
<i>Retain possibility of future full CBP development.</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Address ESA issues (NMFS Columbia River flow objectives, shrub-steppe habitat impacts).</i>	Operational modification designed to avoid effects to Columbia River ESA flow objectives. No significant ESA issues anticipated.	Operational modification designed to avoid effects to Columbia River ESA flow objectives. No significant ESA issues anticipated.	Operational modification designed to avoid effects to Columbia River ESA flow objectives. Potential downstream issues to Lower Crab Creek; ESA listed steelhead.	Designed to avoid effects to Columbia River ESA flow objectives. 4,442 acres shrub-steppe inundated.	Designed to avoid effects to Columbia River ESA flow objectives. 392 acres shrub-steppe inundated. Site predominantly under agricultural production.	Columbia River flows from Grand Coulee Dam to Crab Creek confluence reduced in irrigation season. 6,476 acres shrub-steppe and 1,868 acres wetlands inundated. ESA-listed Upper Columbia River steelhead critical habitat.	Columbia River flows from Grand Coulee Dam to Crab Creek confluence reduced in irrigation season. 3,874 acres shrub-steppe and 1,603 acres wetlands inundated. ESA-listed Upper Columbia River steelhead critical habitat.

Table 34. Study objectives performance comparison for water supply options

Study Objective	Banks Lake Drawdown	Banks Lake Raise	Potholes Reoperation	Dry Coulee	Rocky Coulee	Lower Crab Creek (472 KAF)	Lower Crab Creek (200 KAF)
<i>Provide environmental and recreational enhancements.</i>	Draw downs below current baseline of 1565 feet will likely affect recreation access and experience; fisheries effects anticipated.	Possible impacts to recreational facilities in short term and may extend seasonal access in long-term.	Higher winter elevation may impact recreation facilities in short term and enhance in long term.	New reservoirs may provide additional opportunities, but timing of refill (Sept. - Oct.) and draw down (April-August) may preclude quality experience.	New reservoirs may provide additional opportunities, but timing of refill (Sept. - Oct.) and draw down (April-August) may preclude quality experience. Existing recreation opportunities would be impacted.	New reservoirs may provide additional opportunities, but timing of refill (Sept. - Oct.) and draw down (April-August) may preclude quality experience. Existing recreation opportunities would be impacted.	New reservoirs may provide additional opportunities, but timing of refill (Sept. - Oct.) and draw down (April-August) may preclude quality experience. Existing recreation opportunities would be impacted.
<i>Minimize Study schedule delays (NEPA/Feasibility completed in 2011).</i>	Least amount of study time required.	Requires study of possible modifications to dams.	Requires study of possible modifications to dam.	New infrastructure entails greater engineering design effort and time.	New infrastructure entails greater engineering design effort and time.	New infrastructure entails greater engineering design effort and time.	New infrastructure entails greater engineering design effort and time.
<i>Developed in phases</i>	All water supply options are conducive to sequencing with any water delivery alternative selected.						

Table 35. Comparison of fish and wildlife issues for water supply options

	Banks Lake Drawdown	Potholes Reoperation	Dry Coulee	Rocky Coulee	Lower Crab Creek (472 KAF)	Lower Crab Creek (200 KAF)
Potential for increased bank erosion.	Nesting bird habitat may be inundated.	Increased possibility of downstream releases in winter could impact ESA-listed steelhead and other aquatic and	Inundation of 4,442 acres of fair to good quality shrub-steppe habitat and talus	Inundation of 392 acres of shrub-steppe habitat; fair shrub-steppe corridor through extensive	Inundation of 6,476 acres shrub-steppe, 1,868 acres wetlands.	Inundation of 3874 acres shrub-steppe, 1,603 acres wetland.
Aquatic, emergent, and shoreline vegetation may	Potential short-term impacts to fish					

Table 35. Comparison of fish and wildlife issues for water supply options

Banks Lake Drawdown	Banks Lake Raise	Potholes Reoperation	Dry Coulee	Rocky Coulee	Lower Crab Creek (472 KAF)	Lower Crab Creek (200 KAF)
<p>be impacted.</p> <p>Potential impacts to goose nesting by creating land bridges to nesting islands, allowing access for predators.</p> <p>Reservoir fisheries and other aquatic species impacted through entrainment, increased predation, decreased productivity, and loss of spawning and rearing habitat.</p> <p>Quality of angling experience could be affected (estimated value of \$6 million in 2003).</p>	<p>species and habitats.</p> <p>Inundation of existing shoreline vegetation.</p> <p>Riparian habitat, nesting habitat, and vegetation may be impacted.</p> <p>Potentially supports 7 species of concern.</p>	<p>wildlife resources associated with Lower Crab Creek and Columbia National Wildlife Refuge (CNR).</p> <p>Undesirable fish species may become entrained and introduced into downstream lakes in the CNR, impacting current trout fisheries.</p> <p>Northern leopard frog (State endangered, Federal Candidate) may be affected—last remaining State population occurs in North Potholes.</p> <p>Colonial nesting birds could be impacted by water-level changes.</p> <p>Potentially supports 10 species of concern.</p>	<p>and cliffs (both priority habitats).</p> <p>Potentially supports 19 species of concern.</p> <p>Breeding area for State Candidate species (loggerhead shrikes, sage thrasher).</p> <p>Rare plants in area (sagebrush stickweed <i>Hackelia hispidula</i> var. <i>disjuncta</i>; State Sensitive).</p> <p>Mule deer wintering area.</p> <p>Nonconsumptive wildlife recreation could be impacted.</p>	<p>dryland and irrigated farmland.</p> <p>Important habitat downslope includes mixed grass and seasonal emergent wetland as a result of irrigation seepage.</p> <p>Potentially supports 15 wildlife species of concern.</p> <p>Important for nesting and wintering birds, including nesting burrowing owls (State Candidate).</p>	<p>Diversity of habitat types, including large block of contiguous shrub-steppe habitat, wetland, forest, cliffs and talus slopes, sand dune habitat, marsh areas, greasewood, saltgrass, and extensive riparian zone.</p> <p>Potentially supports 23 wildlife species of concern. Potential occurrence of State endangered or threatened plant species. Known populations of 5 rare plants.</p> <p>Travel corridors for land dwelling mammals and reptiles.</p> <p>Primary staging site for spring and fall migrating sandhill cranes (State Endangered)</p> <p>Potential ESA issues (ESA-listed Upper Columbia River steelhead critical habitat).</p> <p>Breeding habitat for loggerhead shrikes.</p> <p>Waterfowl and game species concentration area. Extensive public hunting opportunities for upland birds, waterfowl, deer, and/ small game, supporting up to 10,000 ducks and geese during the hunting season and early spring.</p>	

6.4.2 Environmental and Other Resource Issues

Environmental issues identified for the water supply options were based on a review of previous investigations involving similar issues and overlaying various GIS datasets over the proposed reservoir footprints. These methods are useful to initially identify potential issues or constraints associated with an option. However, further study and analysis will be required to verify the presence of these resources.

Fish and Wildlife Issues

Potential fish and wildlife issues associated with proposed water supply options include loss of terrestrial habitat due to inundation by proposed reservoirs. Habitats of particular concern in the Study area include shrub-steppe because many Federal and State Species of Concern depend on or use these habitat types

Operational changes at existing reservoirs, such as draw downs below current elevations or increased Columbia River diversions and the resulting increased flow through the CBP, have the potential to degrade fisheries habitat. Increased flows through existing reservoirs may increase fish entrainment and increase the probability of dispersing exotic species (that may degrade habitat or compete or prey on native fish) throughout the CBP and, possibly, to the Columbia River. Dispersion of species known to degrade habitat (e.g., carp), highly fecund species that compete with native species (carp, lake whitefish), and predators (walleye and smallmouth and largemouth bass) are of particular concern. Other potential issues include loss of fish-rearing habitat, predation, and loss of primary productivity.

Draw downs to elevations lower than current operations decrease reservoir volume and may increase the density of all species relative to the amount of habitat remaining, potentially changing predator-prey dynamics. As overall habitat volume decreases, encounters between predator and prey species may increase. Draw downs may also reduce productivity and the amount of suitable spawning grounds. The nests of spawning fish may become dewatered and rearing habitat may be lost. Over time, continuous draw down may diminish both littoral and riparian vegetation, and bank erosion may increase.

Table 36 lists potential occurrence of Federal and State species of concern by water supply option. Existing species-specific data for the proposed water storage sites consist primarily of casual observations, rather than standardized surveys. Further studies will be needed to assess habitat and wildlife resources as well as human use of these resources at the proposed storage sites.

Cultural Resource Issues

Changes in reservoir operations could potentially affect cultural resources located along the reservoir perimeter. Drawing down Banks Lake may expose additional cultural resource sites or add to the cumulative amount of time that resources are exposed, making them susceptible to damage from recreational activities and looting. Modified operations could also increase bank erosion and slumping, which could bury some sites.

Table 36. Potential occurrence of Federal and State species of concern for water supply options

Species of Concern	Banks Lake Drawdown or Raise	Potholes Reoperation	Dry Coulee	Rocky Coulee	Lower Crab Creek
Federal Endangered					
Columbia River basin pygmy rabbit			P	P	P
Upper Columbia River steelhead					K
Federal Candidate					
Washington ground squirrel		P	P	P	K
Greater sage grouse			P	P	
State Endangered					
Northern leopard frog		K	P		P
American white pelican	K	K			P
Sandhill crane			P		K
State Threatened					
Bald eagle	K	K			L
Ferruginous hawk			P	P	K
State Sensitive					
Common loon	K	K			P
Peregrine falcon	K	K	K		K
State Candidate					
Burrowing owl			P	L	L
Golden eagle	K	P	L	P	K
Loggerhead shrike			L	L	K
Merlin			P	P	P
Merriam's shrew	P	P	P	P	P
Washington ground squirrel		P	P	P	K
Sagebrush lizard		P	L	L	K
Sage thrasher			L	L	L
Sage sparrow			L	L	L
Western grebe	K	K			L
Black-tailed jackrabbit			P	P	K
White-tailed jackrabbit			K		
Townsend's big-eared bat			P	P	P
Pallid Townsend's big-eared bat			P	P	P
Striped whipsnake					K

*K= Known occurrence; L = Likely occurrence; P = Possible occurrence.

Constructing new reservoirs may inundate significant resources with later exposure as reservoir elevations fluctuate to meet irrigation demands. The proposed reservoirs are located in coulees, which have a higher probability for prehistoric sites than the surrounding uplands.

Land Use Issues

Modifying operations at existing reservoir facilities may affect current recreation access and quality, as well as other infrastructure and uses surrounding the reservoir shorelines.

Construction of new reservoirs will inundate existing uses and structures. Table 37 identifies potential land use issues associated with each water supply option. This is not meant to be a comprehensive list of issues as comprehensive land use surveys have not yet been made.

Table 37. Land use issues associated with water supply options.

Banks Lake Drawdown¹	Banks Lake 2' Raise	Potholes Reoperation	Dry Coulee	Rocky Coulee	Lower Crab Creek (472 KAF)	Lower Crab Creek (200 KAF)
May affect recreation access and quality. No pump storage generating capacity when reservoir is below elevation 1560 feet. May affect State Highway 155 road stability next to reservoir.	May affect recreation access and land use surrounding reservoir. Possible impacts to nearby communities, canal operations, intake/outlet structures, and other CBP infrastructure.	Increased possibility of downstream releases in winter into Lower Crab Creek may affect roads, bridges, utilities, recreation facilities, other structures, and cropland associated with the CNWR and private entities.	1,342 acres public 3,766 acres private Inundation of at least: 6 residences 10 miles road 258 acres cropland	79 acres public 2,941 acres private Inundation of at least: 6 residences 5 miles road 1,925 acres cropland	7,876 acres public 4,806 acres private Inundation of at least: 20 residences 27 miles road 1.3 miles railroad 2,933 acres cropland	5,411 acres public 3,558 acres private Inundation of at least: 20 residences 21 miles road 0.8 miles railroad 2,291 acres cropland
Infrastructure in the CNWR would be inundated affecting refuge facilities throughout creek bottom, including: ponded areas, dikes, roads, creek crossings, and recreation facilities						